

Researchers investigate what causes cattle to shed shiga toxin-producing *Escherichia coli*

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Shiga toxin-producing *Escherichia coli* (STEC) are foodborne pathogens spread largely by cattle, that can cause hemorrhagic colitis and kidney failure. In an effort to find ways of reducing this problem, Michigan State University investigators show that stress, and the negative energy balance associated with lactation appear to encourage the shedding of STEC, especially in summer. The research is published ahead of print June 24 in *Applied and Environmental Microbiology*, a journal of the American Society for Microbiology.

Besides lactation, the investigators observed an association of STEC with hotter temperatures, which principal investigator Shannon D. Manning said contributes to stress. "This is likely to have a greater impact on animals when crowded, though we did not examine this," she said.

Another possible contributor to STEC in [cattle](#) is nearby wildlife. "In our prior study, we cultured STEC from deer feces found near a dairy pasture and identified evidence of interspecies transmission," said Manning, who is Michigan State University (MSU) Foundation associate professor in the Department of Microbiology and Molecular Genetics, Michigan State University, East Lansing.

In the study, the team sampled feces from more than 1,000 cattle from six dairy farms and five feedlots in Michigan. They counted individual cows as contaminated, or colonized, if they found at least one shiga toxin-positive *E. coli* colony in the fecal sample.

Some results were surprising. It has long been assumed that most shiga toxin-producing *E. coli* are of the O157 strain type. And in many other states, that has been the case, said Manning. But only 19 of the 175 STEC-positive cattle in this study had O157 strains, while most of the shiga toxin-producing *E. coli* had other serotypes. These had different virulence gene profiles within each herd, and even within individual cattle, said Manning.

The multitude of serotypes makes designing interventions that much more complicated, said Manning. "The use of interventions that directly target specific serotypes like O157 will be less useful to manage STEC shedding in cattle given that so many other strain types exist and that the Shiga toxin bacteriophage [viruses that can infect bacteria] can readily infect other *E. coli* residing in both cattle and in the farm environment," she said.

And contrary to the conventional wisdom, non-O157 STEC may often be just as virulent as O157. The deadliest outbreak of *E. coli*, which occurred in Germany, causing 54 deaths, was a non-O157 serotype, said Manning.

So instead of targeting serotypes, "herd-level" management practices might be necessary to decrease transmission of STEC to other susceptible animals and to reduce the potential for contaminating the food supply, said Manning. For example, cattle were more likely to shed STEC during their first lactation. So it might prove useful to isolate them at that time. "Other practices might involve limiting stressors like heat stress, or limiting contact with other animals in extreme temperatures in order to reduce transmission," said Manning. More generally, high risk animals could be isolated.

It's not surprising that multiple strains of *E. coli* would be STEC-positive. The toxin is carried by a type of virus that infects bacteria,

which is called a phage. (Viruses are basically non-living molecular machinery composed of DNA and protein, which have to hijack host cell machinery in order to reproduce.) These particular phages can enter any strain of *E. coli*. Once they do, they incorporate their DNA into the bacterial host genome, which enables the host to produce the toxin.

The study was a major multidisciplinary effort, said Manning. "We needed veterinarians to identify candidate farms and farmers who were willing to participate. Epidemiologists developed the questionnaires used when interviewing farmers. The veterinarians, animal scientists, and students worked up the animals, collected fecal samples, swabbed the rectal junction, and collected blood for immune sampling studies."

"All the samples came back to my lab where the team of microbiology students—graduates and undergrads—cultured the pathogens and confirmed STEC positivity using multiple molecular tests," said Manning. "It would have been extremely difficult to do this study without such a wide range of expertise."

Provided by American Society for Microbiology

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